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Original Research

Hidradenitis Suppurativa Leads to Increased Risk of Wound-Related Complications following Total Joint Arthroplasty

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ABSTRACT

Background: Hidradenitis suppurativa (HS) is a skin disorder characterized by inflammatory skin lesions that are most commonly in the inguinal and axillary regions. These skin lesions are common sites of bacterial growth and are thus a potential risk factor for infection following procedures such as total hip arthroplasty (THA) or total knee arthroplasty (TKA).

Material and methods: Adult patients undergoing THA or TKA for degenerative etiologies were identified from PearlDiver datasets. For THA and TKA, HS patients were matched 1:4 with non-HS patients based on age, sex, and Elixhauser Comorbidity Index. The incidence of 90-day any, severe, minor, and specific adverse events was compiled and compared with multivariate analyses. Five-year revision rates were plotted on Kaplan-Meier survival curves and compared with log-rank tests.

Results: For THA, 331,627 patients were identified, of which HS was noted for 481 patients (0.15%). For TKA, 274,161 patients were identified, of which HS was noted for 290 patients (0.11%). Following THA, HS patients had increased odds of wound dehiscence (odds ratio = 2.55, $P = .002$). Following TKA, HS patients had increased odds of surgical site infection (odds ratio = 1.95, $P = .006$). All other 90-day adverse events were not significantly different. There was no significant difference in 5-year implant survival in either procedure.

Conclusions: HS is a rare but identified comorbidity for those undergoing THA or TKA. Although most 90-day adverse events and 5-year implant survival were similar to those without this condition, specific wound-related issues were elevated by roughly twofold. These findings could help inform patients and surgeons.

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Introduction

Total joint arthroplasty (total hip arthroplasty [THA] and total knee arthroplasty [TKA]) is a commonly performed procedure with overall outstanding results [1–5]. Much work has been done to optimize outcomes and minimize morbidity following such procedures [5]. With that said, patient factors/conditions may be present for certain patients that need to be considered. A major push has been to investigate how more specific risk factors, especially those of rarer etiologies, affect the risk of complications following total joint arthroplasty [6,7].

Hidradenitis suppurativa (HS)—also known as acne inversa—is one such condition. This is a chronic, potentially painful, inflammatory condition of hair follicles which can manifest as nodules, abscesses, draining sinus tracts, and scarring of the skin [8,9]. The lesions caused by HS have been shown to be colonized by a variety of bacteria, likely as a secondary response to HS [8]. These lesions are polymicrobial in nature, although notably, *Staphylococcus aureus* is not commonly cultured [10]. The prevalence of HS varies from 0.05% to 2% of the general population, based on the methodology of the study [11–13]. Clinical manifestations are most common in regions such as the axillae, groin, pubic area, and perineum [10]. Women are twice as common to present with this as men [14], the peak age is between 30 and 39 years [15] and this disproportionately affects African Americans [16].

There is a lack of literature to date regarding outcomes of orthopaedic surgeries in patients with HS. The current study thus

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study sought to compare the rates of perioperative complications and reoperations following either THA or TKA between patients with HS and a matched cohort of patients without HS using the PearlDiver national administrative claims database.

Material and methods

Patient sample

The data for this study were acquired using the 2015-2020 PearlDiver MHip and MKnee datasets to investigate THA and TKA, respectively. The MHip and MKnee datasets are prebuilt datasets on PearlDiver that include patients undergoing hip and knee surgeries, respectively. Our institution has provided an ongoing investigative review board waiver for studies using PearlDiver, as all patient information is deidentified and only at population level.

Patients who underwent THA were identified with the code CPT-27130. Patients who underwent TKA were identified with the code CPT-27447. Only patients with degenerative etiologies (osteoarthritis) were included. Any patients with a primary diagnosis at the time of their THA or TKA of fracture, neoplasm, or infection were excluded. Patients under the age of 18 years or that did not have 90-day follow-ups were also excluded. Patient age, sex, and Elixhauser Comorbidity Index (ECI) were abstracted from the dataset.

Patients with HS were identified with the International Classification of Diseases (ICD) code ICD-10-D-L732. Patients with an HS diagnosis that underwent THA were matched 1:4 to those who underwent THA without an HS diagnosis. The patients were matched based on age, sex, and ECI. Similarly, patients with an HS diagnosis that underwent TKA were matched 1:4 to those who underwent TKA without an HS diagnosis based on age, sex, and ECI.

Ninety-day postoperative outcomes

Ninety-day postoperative adverse events were identified using ICD codes. These were considered independently and aggregated as any adverse events (AAEs), severe adverse events (SAEs), and minor adverse events (MAEs).

SAEs included sepsis, deep vein thrombosis, pulmonary embolism, myocardial infraction, cardiac arrest, and surgical site infection. MAEs included pneumonia, acute kidney injury, urinary tract infection, hematoma, transfusion, and wound dehiscence. AAE was noted if there was an occurrence of an SAE or MAE.

The incidence and timing of reoperations over 5 years were tracked for both THA and TKA using CPT codes for revision of imprint and irrigation and debridement following their surgery. The CPT codes for THA revision of implant were CPT-27134, CPT-27137, and CPT-27138. The CPT codes for TKA revision of implant were CPT-27486, CPT-24787, and CPT-24788.

Statistical analysis

Univariate comparison of the patient characteristics (age, sex, and ECI) was preformed using Fisher exact tests. Due to the significant differences between the groups, 4:1 matching between the non-HS and HS patients was performed to match age, sex, and ECI. Follow-up Fisher exact tests of the matched cohorts were then performed.

Ninety-day postoperative events were then compared between the matched non-HS and HS patients using both univariate fisher exact tests and multivariate logistical regression, which controlled for age, sex, and ECI. Multivariate logistical regressions were used to determine the odds ratios (ORs) and the 95% confidence interval (CI). Multivariate analyses were performed on AAE, SAE, MAE, surgical site infections, and wound dehiscence. Due to the overall low rate of individual adverse events, only the aggregated events, surgical site infections, and wound dehiscence had statistical analyses performed due to the higher patient size and the hypothesized impact on surgical site infections and wound dehiscence.

The overall survival of the implants was tracked based on the incidence of implant revision/reconstruction and the occurence of irrigation and debridements, and the matched groups were compared using a Kaplan-Meier survival curve. Log-rank (Mantel-Cox) tests were used to determine the statistical significance between the survival curves.

Univariate fisher exact tests and log-rank (Mantel-Cox) tests were performed in GraphPad Prism 9 (GraphPad Software, San Diego, CA). Multivariate logistical regressions were performed with PearlDiver analytical tools (PearlDiver Inc., Colorado Springs, CO).

Results

Sample cohorts

For THA, 331,627 patients were identified, of which HS was noted for 481 (0.15%) (Table 1). On univariate analyses, the HS patients were younger, had a higher ECI, and were more likely to be female than the non-HS patients ($P < .001$). Once matched based on age, sex, and ECI, there were 1906 non-HS patients and 477 HS patients with no residual differences in the groups.

For TKA, 274,161 patients were identified, of which HS was noted for 290 (0.11%) (Table 2). On univariate analysis, the HS patients were younger, had a higher ECI, and were more likely to be female than the non-HS patients ($P < .001$), similar to the THA groups. After matching based on age, sex, and ECI, there were 1120 non-HS patients and 280 HS patients, again with no residual differences between the groups.

Ninety-day adverse events

The incidence of all adverse events for both THA and TKA is shown in Tables 3 and 4, respectively. Due to low number of some

Table 1
Patient characteristic of THA patients with and without hidradenitis suppurativa.

Characteristics	Not-matched group			Matched group		
	Non-HS THA	HS THA	*P*-value	Non-HS THA	HS THA	*P*-value
Sample size	331146 (99.85%)	481 (0.15%)		1906 (80%)	477 (20.0%)	
Age (SD):	63.5 (10.0)	54.8 (10.7)	**< .001**	55.1 (10.7)	54.9 (10.6)	.24
Sex			**< .001**			1
Female	186712 (56.4%)	322 (66.9%)		1280 (67.2%)	320 (67.1%)	
Male	144434 (43.6%)	159 (33.1%)		626 (32.8%)	157 (32.9%)	
ECI	4.13 (3.20)	6.85 (4.00)	**< .001**	6.76 (3.85)	6.77 (3.86)	1

HS, hidradenitis suppurativa; ECI, Elixhauser Comorbidity Index; THA, total hip arthroplasty.
Matched based on age, sex, and ECI 4:1 non-HS patients to HS patients.
Bold indicates significance of $P < .05$.

Table 2
Patient characteristics of TKA patients with and without hidradenitis suppurativa.

Characteristics	Not-matched group			Matched group		
	Non-HS TKA	HS TKA	*P*-Value	Non-HS TKA	HS TKA	*P*-Value
Sample size	N = 273871 (99.89%)	N = 290 (0.11%)		N = 1120	N = 280	
Age (SD):	65.3 (8.8)	57.3 (8.0)	**< .001**	57.3 (8.9)	57.3 (8.8)	.92
Sex			**< .001**			1
Female	172846 (63.1%)	223 (74.5)		864 (77.1%)	216 (77.1%)	
Male	101025 (36.9%)	67 (22.1%)		256 (22.9%)	64 (22.9%)	
ECI	2.5 (2.2)	6.7 (3.5)	**< .001**	6.3 (3.0)	6.3 (3.0)	1

TKA, total knee arthroplasty; HS, hidradenitis suppurativa; ECI, Elixhauser Comorbidity Index.
Matched based on age, sex, and ECI 4:1 non-HS patients to HS patients.
Bold indicates significance of $P < .05$.

Table 3
Univariate analyses for 90-day outcomes of total hip arthroplasty.

Complications	Matched non-HS patients	Matched HS patients	*P*-value
Sample size	1906	477	
Any adverse events	416 (21.8%)	108 (22.6%)	.71
Severe adverse events	147 (7.7%)	33 (6.9%)	.63
Surgical site infection	43 (2.3%)	12 (2.5%)	.73
Sepsis	50 (2.6%)	21 (4.4%)	-
Deep vein thrombosis	77 (4.0%)	17 (3.6%)	-
Pulmonary embolism	44 (2.3%)	*	-
Myocardial infarction	25 (1.3%)	*	-
Cardiac arrest	*	*	-
Pancreatitis	14 (0.7%)	*	-
Minor adverse events	403 (21.1%)	112 (23.5%)	.26
Wound dehiscence	29 (1.5%)	18 (3.8%)	**.003**
Pneumonia	83 (4.4%)	27 (5.7%)	-
Urinary tract infection	258 (13.5%)	68 (14.3%)	-
Acute kidney injury	127 (6.7%)	30 (6.3%)	-
Transfusion	128	16	-
Hematoma	29 (1.5%)	*	-

HS, hidradenitis suppurativa.
Bold indicates significance of $P < .05$.
An * indicates less than 10 patients.

Table 4
Univariate analyses of 90-day outcomes of total knee arthroplasty.

Complications	Matched non-HS patients	Matched HS patients	*P*-value
Sample size	N = 1120	N = 280	
Any adverse events	247 (22.1%)	57 (20.4%)	.57
Severe adverse events	110 (9.8%)	25 (8.9%)	.58
Surgical site infection	61 (5.4%)	28 (10.0%)	**.009**
Sepsis	12 (1.1%)	*	-
Deep vein thrombosis	45 (4.0%)	*	-
Pulmonary embolism	29 (2.6%)	*	-
Myocardial infarction	*	0	-
Cardiac arrest	*	0	-
Pancreatitis	*	*	-
Minor adverse events	173 (15.4%)	45 (16.1%)	.78
Wound dehiscence	17 (1.5%)	*	-
Pneumonia	28 (2.5%)	13 (4.6%)	-
Urinary tract infection	53 (4.7%)	25 (8.9%)	-
Acute kidney injury	43 (3.8%)	12 (4.3%)	-
Hematoma	12 (1.1%)	0	-
Transfusion	76 (6.8%)	*	-

HS, hidradenitis suppurativa.
Bold indicates significance of $P < .05$.
An * indicates less than 10 patients.

Table 5
Multivariate analyses of 90-day outcomes following total hip arthroplasty.

Complications	Odds ratio	95% confidence interval	*P*-value
Any adverse event	1.07	0.85-1.35	.57
Severe adverse event	1.11	0.79-1.54	.52
Minor adverse event	1.17	0.90-1.50	.24
Surgical site infection	1.12	0.56-2.08	.74
Wound dehiscence	2.55	1.37-4.62	**.002**

ECI, Elixhauser Comorbidity Index; HS, hidradenitis suppurativa.
Bold indicates significance of $P < .05$.
Controlled for age, sex, and ECI.

adverse events, the exact number could not be recorded to protect patient privacy/database requirements. As a result, only aggregate adverse events (AAE, SAE, and MAE) and events relating to the surgical site (surgical site infection and wound dehiscence) had statistical comparison performed.

On univariate analyses of the THA groups, HS patients had significantly more wound dehiscence (1.5% vs 3.8%, $P < .003$). For TKA groups, HS patients had significantly more surgical site infections (5.4% vs 10.0%, $P = .009$).

Multivariate analyses (controlling for age, sex, and ECI) only found HS patients to have significantly greater odds of only wound dehiscence for THA (OR: 2.55, $P = .002$) and surgical site infection for TKA (OR = 1.95, $P = .006$) (Tables 5 and 6, respectively). There were no other significant differences identified for those with and without HS.

Five-year reoperation

The rates of revision of the implant and irrigation and debridement for THA and TKA surgeries were tracked over 5 years and shown on Kaplan-Meier curves (Figs. 1 and 2, respectively). For THA, the non-HS control group had 213 reoperations (5-year implant survival rate of 88.8%), and the HS group had 67 revisions (5-year implant survival rate of 86.0%). These findings did not represent a difference between those with and without HS by the log-rank test ($P = .07$, Fig. 1). Over the first 90 days, there was also no significant difference in return to the operating room between the non-HS group and the HS group (survival rate of 97.3% vs 97.7%, $P = .65$).

For the TKA, the non-HS control group had 99 reoperations (5-year implant survival rate of 91.6%), and the HS group had 28 revisions (5-year implant survival rate of 90.0%). Again, these findings did not represent a difference between those with and without HS by the log-rank test ($P = .54$, Fig. 2). Over the first 90 days, there was not a significant difference in return to the operating room between the non-HS group and the HS group (98.6% vs 97.5%)

Discussion

HS is a chronic disease of hair follicles that affects 0.05%-2% of people [10–12]. The impact of this condition on orthopaedic surgery outcomes, such as THA and TKA, has not been described. The current study utilized a large national database to compare the outcomes of THA and TKA patients with and without HS using cohort matching and multivariate analysis.

Aggregated AAEs, SAEs, and MAEs were not different for THA and TKA patients with and without HS. This was not an assumed finding as HS is associated with adverse events after procedures such as flap surgery [17,18]. However, HS has been associated with various comorbidities, such as obesity, metabolic syndrome, and diabetes, which could have been adjusted for with the ECI matching of the current study [11].

On the other hand, HS was associated with wound dehiscence following THA (OR: 2.55). Wound dehiscence and infections are common after excision of HS lesions, which are commonly found around the hip and axillary region [17,18]. Skin changes related to HS near surgical incisions could increase rates of wound dehiscence, perhaps due to subacute bacterial infections secondary to HS. A case report describes recurrent wound dehiscence after Cesarean section and postulates that HS may have been a factor, but there is little other literature on the topic [19].

In addition, HS was associated with surgical site infection following TKA (OR: 1.61). In numerous case reports, HS has been connected to increased potential risk of infections, including osteomyelitis [20–23]. HS lesions have been shown to consist of varied microbiome, which leads to a risk of a mixed bacterial infection [17]. A proposed mechanism for this relationship is that HS allows for the proliferation of bacteria by enabling the creation of cavities that support deep soft-tissue colonies [23].

Importantly, despite the increased wound-related issues for those with HS, there was not a difference in 5-year implant survival noted for THA or TKA. This suggests that, once through the short-term wound-related issues, implant survival should be similar for those with HS as those without HS.

The current study has several limitations. Being a retrospective cohort study performed using a national database, we can only determine associations, not causation. Additionally, the data provide presence or absence of HS diagnosis, but cannot determine locations of HS skin changes, when the patients were diagnosed, or the severity of the disease, nor whether the patients have received or are currently receiving any treatment for their HS.

Table 6
Multivariate analyses of HS on 90-day outcomes following total knee arthroplasty.

Complications	Odds ratio	95% confidence interval	*P*-value
Any adverse event	0.89	0.63-1.24	.51
Severe adverse event	0.90	0.56-1.42	.64
Minor adverse event	1.05	0.72-1.51	.81
Surgical site infection	1.95	1.20-3.11	**.006**
Wound dehiscence	1.18	0.38-3.02	.75

ECI, Elixhauser Comorbidity Index; HS, hidradenitis suppurativa.
Bold indicates significance of $P < .05$.
Controlled for age, sex, and ECI.

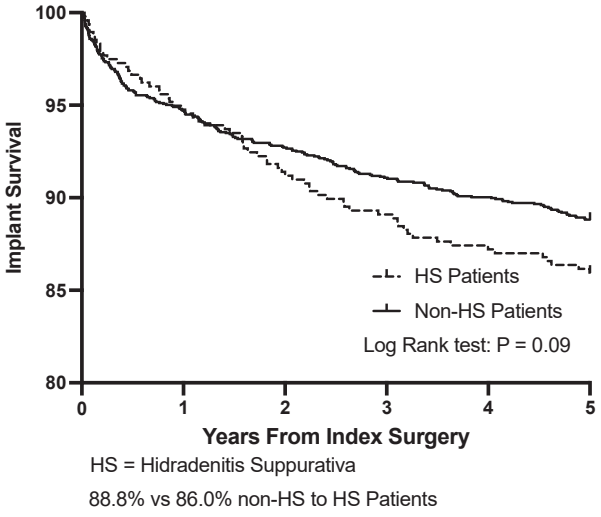

Figure 1. Revision-free survival over 5 years following THA. Kaplan-Meier curve showing 5-year revision rate of total hip arthroplasty in patients with or without hidradenitis suppurativa. HS, hidradenitis suppurativa; THA, total hip arthroplasty.

Conclusions

Overall, patients with HS undergoing THA and TKA have similar short-term aggregated outcomes and 5-year implant survival compared to patients without HS. However, in both procedures, HS was associated with increased wound-related issues in the 90 days following surgery, even after matching for age, sex, and ECI. In the setting of little literature on this topic, this information should be helpful for patient counseling and surgical planning.

Conflicts of interest

Daniel H. Wiznia is a paid consultant at and receives <$2500 from Intellijoint and <$10,000 from Materialize; Jonathan N. Grauer is the Editor-in-Chief of the North American Spine Society Journal and board member of the North American Spine Society, is a member of the board and website committee of the Lumbar Spine Research Society, and is a member of the membership committee of the Cervical Spine Research Society; all other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2019.12.004.

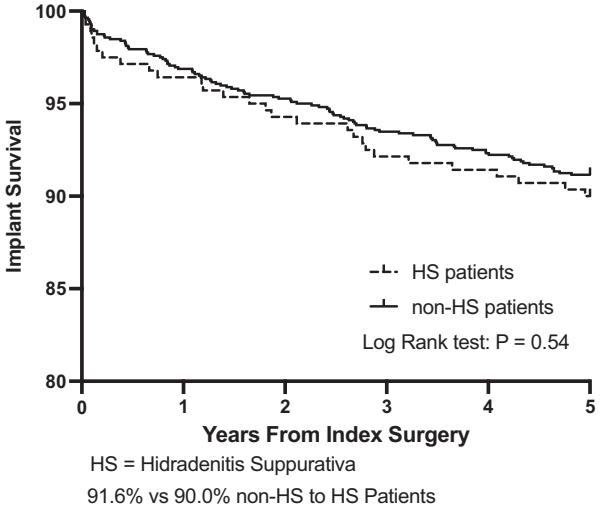

Figure 2. Revision-free survival over 5 years following TKA. Kaplan-Meier curve showing 5-year revision rate of total knee arthroplasty in patients with or without hidradenitis suppurativa. HS, hidradenitis suppurativa; TKA, total knee arthroplasty.

Informed patient consent

The author(s) confirm that informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this article.

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